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IDENTIFICATION AND ANALYSIS OF ARMY HELICOPTER RELIABILITY AND MAINTAINABILITY PROBLEMS AND DEFICIENCIES

VOLUME IV
LIGHT OBSERVATION HELICOPTERS (OH-6, OH-58)

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April 1972

EUSTIS DIRECTORATE

U. S. ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LABORATORY

FORT EUSTIS, VIRGINIA

CONTRACT DAAJ02-71-C-0051

AMERICAN POWER JET COMPANY

RIDGEFIELD, NEW JERSEY

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April 1972

IDENTIFICATION AND ANALYSIS OF ARMY HELICOPTER RELIABILITY AND MAINTAINABILITY PROBLEMS AND DEFICIENCIES

Volume IV
Light Observation Helicopters
(OH-6, OH-58)

American Power Jet Company Report 670-5

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ABSTRACT

This volume presents discussions of a series of reliability and maintainability problems related to Army Light Observation Helicopters (OH-6, OH-58). A detailed discussion of the standard format used for problem presentation and of the various analysis elements within the standard format is provided in Volume I.

TABLE OF CONTENTS

	Page
ABSTRACT	iii
HELICOPTER TMS: OH-6A	
Problem No: 01-1 - Horizontal Stabilizer Failures. . .	1
01-2 - Windshield Failures	4
01-3 - Polycarbonate Component Failures. .	6
01-4 - Cabin Door, Access Door Latch, and Related Hardware Failures	9
01-5 - Rivet Failures.	12
02-1 - Landing Gear Skid, Strut, and Part Failures.	14
02-2 - Landing Gear Damper Malfunctions and Failures.	17
02-3 - Landing Gear Fairing Assembly Failures.	19
04-1 - Tail Rotor Drive System Failures and Malfunctions.	22
04-2 - Tail Rotor Hub and Blade Failures and Malfunctions.	25
04-3 - Main Transmission Malfunctions and Failures.	28
04-4 - Main Rotor Blade Failures	32
04-5 - Bearing Failures.	34
09-1 - Battery Malfunctions and Failures .	38
HELICOPTER TMS: OH-58A	
Problem No: 01-1 - Armor Side Panel Hinge Assembly Malfunctions.	40
01-2 - Crew Door, Passenger Door, and Cowl Access Door Latches and Related Hardware Failures and Malfunctions.	42
01-3 - Fastener and Rivet Failures	45
04-1 - Tail Rotor Drive Shaft Component Failures.	47
04-2 - Drive Shaft Assembly (Short Shaft) Coupling Seal Failures.	50
04-3 - Tail Rotor Hub Failures and Malfunctions	53

TABLE OF CONTENTS (Continued)

	Page
Problem No: 11-1 - Flight Control Servo Actuator Failures.	56
Data Sources - OH-6A Analysis.	58
Data Sources - OH-58A Analyses	60
DISTRIBUTION	62

Helicopter TMS: OH-6A
Problem No.: 01-1

Problem Title: Horizontal Stabilizer Failures

Problem Description:

A. Component Identification -

	P/N
Horizontal Stabilizer	369A 3600
" "	369A 3600-601
" "	369A 3600-603

B. Description of Failure -
Stabilizers cracked, dented, torn, broken; rivets failed.

C. Cause of Failure -
Material unable to withstand operating stresses, particularly high-frequency vibrations from the tail rotor assembly which cause the stabilizer to vibrate at its resonance frequency, and vibration and blast from weapons firing.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data:
AVSCOM MIRF data show the following mean times to removal for failures (excluding crash and combat damage):

P/N	Mean Time to Removal (hours)	No. of Removals
369A 3600	320	68
369A 3600-601	440	24
369A 3600-603	530	96

The Hughes Tool Company Report 10, Serialized Assembly Failure History, showed the following mean times to removal:

P/N	Mean Time to Removal (hours)	No. of Removals
369A3600	277	52
369A3600-601	354	9
369A3600-603	431	4

Problem No.: 01-1 (Continued)

F. Mission and Deployment Factors -
Common to all missions and deployments.

Problem Impact:

A. Safety Factors -
Horizontal stabilizer failures have not presented a serious safety problem. From initial deployment through 31 March 1971, USABAAR has recorded 5 mishaps, all precautionary landings identified to horizontal stabilizer failures.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	3.5 - 4.5	Direct Support
Repair	1.0 -16.0, depending on type of repair	Direct Support and General Support, mostly Direct Support

C. Aircraft Availability Factors -
Downtime for replacement: 3 - 5 hours, assuming a two-man crew.

Repair of stabilizer on aircraft: 2 - 3 hours.

Remedial Actions:

1. ECP 637, approved in July 1967, added a weight to the tip of the stabilizer, changing its resonant frequency, effective with production aircraft 66-7854. Retrofit was provided by MWO 55-1520-214-30/6, May 1968.

2. There have been three configurations of the stabilizer over the life of the OH-6A. As shown in the Failure Rate Data above, each has shown improvement in reliability over the preceding configuration(s).

Data Sources:

1,2,3,4,6,7,9,10,11,12,14,21,22.

Problem No: 01-1 (Continued)

Cross References:

TMS	Problem Number
UH-1	01-5
AH-1	01-3
CH-47	01-1
CH-54	-
OH-6	01-5
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 01-2

Problem Title: Windhshield Failures

Problem Description:

A. Component Identification -

	P/N
Windshield Assembly	5001422
	5001423
	5001424
	5001425
	369A2420-1
	369A2402-2

B. Description of Failure -
Windshields crazed, cracked, broken.

C. Cause of Failure -
Abrasion, dropping of tools or other heavy objects on lower sections. Materials used (stretched acrylic) not adequate to meet operating stresses.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
Ft. Rucker demand data for year ending 30 April 1971 showed mean times between replacement for windshield assemblies as follows:

	P/N	Hours
Lower Assemblies	5001422 5001423	900
Top (Roof) Assemblies	369A2420-1 369A2402-2	650

No demands were recorded for center windshield P/Ns 5001424 and 5001425. Actual failures requiring maintenance actions were probably higher, as correction by repair is not included in the above means.

Problem No.: 01-2 (Continued)

F. Mission and Deployment Factors -

Common to all missions and deployments. Abrasion, however, is more severe in dusty, sandy environments such as Vietman and Ft. Rucker.

Problem Impact:

A. Safety Factors -

Windshield failures do not present an immediate safety hazard. USABAAR recorded no mishaps from such failures through March 1971.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	8 - 10	Direct Support

C. Aircraft Availability Factors -

Downtime for windshield replacement: 1.5 - 2 days.

Remedial Actions:

ECP 337 provides a stronger polycarbonate windshield to replace the stretched acrylic lower windshield where much of the damage occurs. The ECP was approved in July 1969 for retrofit through attrition and no production effectivity.

Data Source:

1,2,3,4,6,7,9,10,12,14,20.

Cross References:

TMS	Problem Number
UH-1	01-2
AH-1	01-2, 12-1
CH-47	01-2
CH-54	-
OH-6	-
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 01-3

Problem Title: Polycarbonate Component Failures

Problem Description:

A. Component Identification -
Most components constructed of polycarbonate material. Major problems related to:

	P/N
Transmission Oil Cooler Blower Scroll Assembly	369A5306
Transmission Drain Assembly	369A5020
Heater Ducts	369A8052-19, -21
Fuel Inlet Shield	369A2017

Some problems were also related to the:

Junction Box	369A4209
Log Book Holder	369A4011
Pilot's Floor Support	369A2545-75

B. Description of Failure -
Components crack, break.

C. Cause of Failure -
Inability of material to withstand vibration and other stresses related to operating environment.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
Ft. Rucker demand data for the year ending 30 April 1971 showed the following mean times to replacement:

	Hours
1. Transmission Oil Cooler Blower Scroll	500
2. Transmission Drain Assembly	900
3. Heater Ducts, P/N 369A8052-19	1100
" " P/N 369A8052-21	2200
4. Fuel Inlet Shield	500

The Hughes Tool Company Report 10, Serialized Assembly Failure History, showed a mean time to removal for the scroll assembly of 425 hours based on 5 failures, and 500 hours for the transmission drain assembly based on 9 failures.

Problem No.: 01-3 (Continued)

The actual mean time to removal was probably lower than the factors shown above, as items returned to service through repair are not included.

F. Mission and Deployment Factors -
Common to all missions and deployments.

Problem Impact:

A. Safety Factors -
USABAAR records for the period 1 January 1967 - 31 March 1971 show no mishaps resulting from polycarbonate component failures.

B. Maintenance Workload Factors -
The components listed above, except for the oil cooler blower scroll assembly, can be replaced in 3 manhours or less. The scroll assembly requires 4 - 5 manhours for replacement. All are allocated to direct support level for replacement except the fuel inlet shield, where replacement is authorized at organizational level.

C. Aircraft Availability Factors -
Aircraft downtime for replacement of any one of the above items ranges from 1 to 10 hours.

Remedial Actions:

The OH-6A Product Improvement Program includes work on all of the polycarbonate components listed above. As of August 1971, design improvements resulting from the program consisted of replacing polycarbonate material with fiberglass for all items except pilot's floor support, where aluminum is proposed.

Data Sources:

1,2,3,4,5,6,7,9,10,13,15,16,20,21,23.

Problem No.: 01-3 (Continued)

Cross References:

TMS	Problem Number
UH-1	01-3, 01-5
AH-1	-
CH-47	01-3
CH-54	-
OH-6	-
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 01-4

Problem Title: Cabin Door, Access Door Latch, and Related Hardware Failures

Problem Description:

A. Component Identification -

	P/N
Pilot, Copilot, Access Door	369A 2002-907, -908
Cargo Access Door	369A 2012-901, -902
Engine Access Door	369A 2024-601, -602, -615, -616

Related latches, hinges, cables, handles, etc.

B. Description of Failure -

Latches and hinges crack and break; rivets and fasteners fall off; cables are hard to adjust and fail; handles break, malfunction, and fail.

C. Cause of Failure -

Inadequate design and material for operating environmental stresses, particularly vibration.

D. Period and Duration of Problem -

Early deployment to present

E. Failure Rate Data -

Ft. ker demand data for the year ending 30 April 1971 provides e following mean times between replacement:

1. Pilot and Copilot doors. Both doors have the same federal stock number and separate MTBRs for each door could not be determined. The data showed that a door was replaced approximately every 700 flying hours. Additionally, a door hinge required replacement every 100 hours, a windowpane every 600 hours, a cable every 100 hours, an emergency release assembly every 400 hours, and a hinge spring every 125 hours.

2. Cargo doors. A door was replaced every 900 hours. Additionally, a door hinge was also required every 900 hours, a cable assembly every 60 hours, and a release assembly every 400 hours.

Problem No.: 01-4 (Continued)

3. A door handle common to both pilot and cargo doors was required every 100 hours and a latch lever, also common to both, every 80 hours.

4. Engine access doors. One of the two doors was replaced every 1000 hours. Additionally, a door hinge was replaced every 700 hours, a hook every 550 hours, and a bracket every 700 hours.

The Hughes Tool Company Report 10, Serialized Assembly Failure History, showed a mean time to removal of 372 hours for the engine access door based on 12 removals.

The total effect of all failures is an almost constant requirement for maintenance on a door or one of its components.

F. Mission and Deployment Factors -
Common to all missions and deployments

Problem Impact:

A. Safety Factors -
Door failures accounted for 4 of 19 mishaps classified as incidents recorded by USABAAR for the OH 6A from its deployment through 31 March 1971. In at least two cases, the door came off in flight, a potentially dangerous occurrence if the tail rotor is struck.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace door	2.0 - 3.0	Direct Support
Repair door	1.0 - *	Direct Support primarily

C. Aircraft Availability Factors -
Downtime can range from 1 or 2 hours to a few days, depending on type and amount of repairs required.

* Manhours for repair vary widely with type of repair and problems of fitting and adjusting.

Problem No.: 01-4 (Continued)

Remedial Actions:

ECP 679R1, approved in September 1968, provided improved latches and hinges for the engine access door, effective with production aircraft 68-17140. Retrofit was provided by MWO 55-1520-214-50/3, December 1969.

Data Sources:

1,2,3,4,5,6,7,9,10,12,14,15,16,17,18,20,23.

Cross References:

TMS	Problem Number
UH-1	-
AH-1	01-4, 01-6, 01-8
CH-47	01-1, 01-4, 01-5
CH-54	-
OH-6	-
OH-58	01-1, 01-2, 01-3

Helicopter TMS: OH-6A
Problem No.: 01-5

Problem Title: Rivet Failures

Problem Description:

A. Component Identification -

Rivets used on the fuselage, tail boom and other areas of the OH-6A.

B. Description of Failure -

Rivet holes become enlarged and elongated; rivets loosen and fall out. While the condition is general, some specific areas which have been particularly troublesome are the tail boom (upper and lower seams), vertical and horizontal stabilizers, landing gear tubes, abrasion strips, and fairings and fuselage sections.

C. Cause of Failure -

The combination of vibration from dynamic components, shock, blast and vibration from weapons, and the thin skin used in the fuselage and some other areas of the aircraft.

D. Period and Duration of Problem -

Early deployment to present. Most problems were discussed by the Aviation Test Board in their reports of the reliability evaluation and confirmatory tests of the OH-6A in August 1968.

E. Failure Rate Data -

There are almost no data available describing failures of common hardware of this type. Ft. Rucker demand data shows a usage for one year of 203 rivets used to attach the abrasion strip to the landing gear. This usage, related to approximately 6500 flying hours, indicates a rivet replacement every 30 - 35 hours. Although data are not available for usage of most rivets, the general acknowledgement of the problem indicates a high frequency of failure.

F. Mission and Deployment Factors -

Common to all missions and deployments

Problem No.: 01-5 (Continued)

Problem Impact:

A. Safety Factors -

Rivet failures do not ordinarily present safety problems. Two mishaps, both precautionary landings, were recorded by USABAAR from initial deployment of the OH-6A through 31 March 1971.

B. Maintenance Workload Factors -

Replacement of a single rivet requires little time to accomplish. Large-scale and frequent replacements can be time-consuming. Accessibility may present problems in some areas of the aircraft. Most riveting replacements are allocated to direct support and higher levels of maintenance.

C. Aircraft Availability Factors -

Downtime varies considerably, depending on the quantity of rivets to be replaced and their location on the aircraft. Rivet replacements can extend inspection downtime requirements and produce unscheduled maintenance.

Remedial Action:

No direct remedial actions are known. As discussed in problems under Functional Group 04, actions to reduce tail rotor vibrations tend to reduce rivet failures, particularly in the tail boom and stabilizers. Changes in the design of the landing gear discussed in Problem 02-1 resulted in replacement of rivets by screws for attaching abrasion strips to tubes and for installation of the tube with bolts.

Data Sources:

1,2,3,4,5,6,7,9,10,12,15,16,20,22.

Cross References:

TMS	Problem Number
UH-1	01-5
AH-1	01-1, 01-8
CH-47	01-1
CH-54	-
OH-6	01-1, 01-4
OH-58	01-3

Helicopter TMS: OH-6A
Problem No.: 02-1

Problem Title: Landing Gear Skid, Strut, and Part Failures

Problem Description:

A. Component Identification -

	P/N
Landing Gear Skid Assembly	369A 6100-1, -2
Landing Gear Strut Assembly	369A 6001-903, -904
Strut Bracket	369A 6200-17
Skid Fitting	369A 6107-3
Abrasion Strip	369A 6102-5

B. Description of Failure -

Assemblies and components cracked, bent, scored, worn, broken.

C. Cause of Failure -

Hard landings, run-on landings on rough surfaces, movement over rough surfaces on ground handling wheels, and frequent landings and autorotation during training exercises. Material is inadequate to withstand stresses resulting from these operations and conditions.

D. Period and Duration of Problem -

Early deployment to present

E. Failure Rate Data -

Ft. Rucker demand data for the year ending 30 April 1971 shows mean times between replacement of the assemblies and components listed above as follows:

	P/N	Hours
Landing Gear Skid Assembly	369A 6100-1	700
Landing Gear Skid Assembly	369A 6100-2	800
Landing Gear Strut Assembly	369A 6001-903	400
Landing Gear Strut Assembly	369A 6001-904	700
Strut Bracket	369A 6200-17	300
Skid Fitting	369A 6107-3	450
Landing Gear Abrasion Strip	369A 6102-5	800

Problem No.: 02-1 (Continued)

When these failures are considered in total, landing gear maintenance is required at least once every 100 hours at Ft. Rucker. While landing gear usage is greater at Ft. Rucker because of training operations, failures are also frequent in other areas.

Hughes Tool Company Report 10, Serialized Assembly Failure History, shows the following mean times to removals.

	No. of Removals Reported	Hours
Landing Gear Skid Assy (all part numbers)	18	260
Skid Fitting	6	520

F. Mission and Deployment Factors -

Common to all missions and deployments, but probably most severe at the Aviation Center, Ft. Rucker.

Problem Impact:

A. Safety Factors -

USABAAR recorded no mishaps resulting from landing gear failures for the OH-6A through March 1971.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace skid assembly	4.0 - 5.0	Direct Support
Strut assembly	5.0 - 6.0	Direct Support
Strut bracket	5.0 - 6.0	Direct Support
Fitting	5.0 - 6.0	Direct Support
Abrasion strip	.8 - 1.2	Direct Support

C. Aircraft Availability Factors -

Downtime for skid, strut, bracket or fitting replacement: 1/2 - 1 day, assuming a two-man crew. Abrasion strip replacement requires 2 hours downtime.

Remedial Action:

ECP 1251 was approved January 1969 effective with production aircraft 68-17353 and subsequent. Fleet retrofit was provided through attrition and at time of cyclic maintenance or crash damage repair. The ECP changed the material of the

Problem No.: 02-1 (Continued)

abrasion plate and increased its area. An additional abrasion plate was added forward of the front plate to provide protection during ground handling. The wall thickness of the tube was increased to provide more strength, the tubes were made interchangeable, and provision for installation with bolts was made.

Data Sources:

1,2,3,4,6,7,9,14,15,16,20,22.

Cross References:

TMS	Problem Number
UH-1	02-1
AH-1	02-1
CH-47	-
CH-54	-
OH-6	02-2, 02-3
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 02-2

Problem Title: Landing Gear Damper Malfunctions and Failures

Problem Description:

A. Component Identification -
Landing Gear Damper Assembly, P/N 369A 6300

B. Description of Failure -
Dampers leak, suffer internal failure, wear excessively, collapse; retainer shears.

C. Cause of Failure -
Leakage caused by puncture of the bladder by the retaining ring when damper is compressed and extended rapidly, such as during a hard landing. Shearing of retainer results from excessive extension of landing gear, which frequently occurs during a fast takeoff with a load hung on the landing gear. Inadequacy of material to meet mission operating conditions is a primary cause of most failures.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
The AVSCOM MIRF report shows a mean time to removal for failure causes (excluding combat and crash damage) of approximately 500 hours, based on 474 removals. Ft. Rucker demand data for the year ending 30 April 1971 indicated a mean time between replacement of slightly less than 400 hours. As there are four dampers per helicopter, the mean time between occurrences when a helicopter requires damper replacement would be one-fourth the component MTBR or 100 hours.

The Hughes Tool Company Report 10, Serialized Assembly Failure History, shows a mean time to removal of 450 hours based on 34 removals.

F. Mission and Deployment Factors -
Common to all missions and deployments, but a more severe problem in Vietnam and at Ft. Rucker, where combat and training operations produce more severe stresses on dampers.

Problem No.: 02-2 (Continued)

Problem Impact:

A. Safety Factors -

USABAAR records for the period 1 January 1967 - 31 March 1971 show no mishaps attributed to landing gear damper failures.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	1.0 - 1.5	Organizational

C. Aircraft Availability Factors -

Downtime for replacement of a single damper assembly is 3 - 5 hours.

Remedial Actions:

1. Retainer strengthened by changing material from aluminum to steel.

2. Product Improvement Program, Task 0008AF, was initiated to determine how to extend service life of the dampers, and ECP 3035 was submitted as a result of the task.

Data Sources:

1,2,3,4,5,6,9,11,14,15,16,20,21,22,23.

Cross References:

TMS	Problem Number
UH-1	01-1, 02-1
AH-1	01-1
CH-47	-
CH-54	-
OH-6	02-1, 02-3
OH-54	-

Helicopter TMS: OH-6A
Problem No.: 02-3

Problem Title: Landing Gear Fairing Assembly Failures

Problem Description:

A. Component Identification -

	P/N
Front Fairing Assembly, LH	369A 6200-905, -907
Front Fairing Assembly, RH	369A 6200-906, -908
Rear Fairing Assembly, LH	369A 6200-901, -903
Rear Fairing Assembly, RH	369A 6200-902, -904

B. Description of Failure -

Fairings crack, suffer bonding failure, break, tear around attaching hardware.

C. Cause of Failure -

Chafing on fuselage and landing gear, possibly some damage by pilots and maintenance personnel using fairing as aid to enter and leave the helicopter, hard landings, and landings in rough terrain. Material unable to withstand operating environmental stresses.

D. Period and Duration of Problems -

Early deployment to present

E. Failure Rate Data -

Ft. Rucker demand data for the year ending 30 April 1971 showed the following mean times between replacement:

	Hours
Front Left-hand Fairings	275
Front Right-Hand Fairings	275
Rear Left-Hand Fairings	375
Rear Right-Hand Fairings	350

Actual mean time between failure is probably lower, as the above MTBR includes only replacements and does not include corrections made by repair.

F. Mission and Deployment Factors -

Common to all missions and deployments.

Problem No.: 02-3 (Continued)

Problem Impact:

A. Safety Factors -

Fairing failures do not present a safety problem. Only one mishap (a precautionary landing) for a fairing failure was recorded by USABAAR for the period 1 January 1967 - 31 March 1971.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	2.0 - 3.0	Direct Support

C. Aircraft Availability Factors -

Downtime for replacement: 1.5 - 3.0 hours assuming a two-man crew.

Remedial Actions:

Hughes Aircraft reported in August 1971 that under the OH-6A Product Improvement Program, the following improvements had been made to the fairings:

1. Left-Hand and right-hand fairings, both forward and rear, made interchangeable.

2. An aluminum collar installed at the intersection of the strut and skid (which permits use on either side) to increase the life of the fairing at its critical point.

3. Fairings strengthened by adding an extra layer of fiberglass cloth at front.

4. Assembly and disassembly simplified by use of screws and nuts in place of rivets and bonding.

Data Sources:

1,2,3,4,5,6,9,15,16,20,21,22.

Problem No.: 02-3 (Continued)

Cross References:

TMS	Problem Number
UH-1	02-1
AH-1	02-2
CH-47	01-3
CH-54	-
OH-6	02-1, 02-2
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 04-1

Problem Title: Tail Rotor Drive System Failures and Malfunctions

Problem Description:

A. Component Identification -

	P/N
Tail Rotor Drive Shaft	369A 5518-601
Coupling	369A 5501
Coupling	369A 5517

B. Description of Failure -
Shaft dented, sheared, worn; couplings cracked, sheared, worn.

C. Cause of Failure -
The AVSCOM MIRF report shows that about 35% of shaft and 70% of coupling removals for failure recorded in the report resulted from crash and battle damage. Remaining major causes of shaft removals were excessive vibration, out of round, sudden stops, dented, broken and scored. Other causes for coupling removals were worn, cracked, sheared and sudden stops.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
The mean times to removal shown below are based on AVSCOM MIRF data covering removals from initial deployment through 30 June 1970 for the shaft and coupling P/N 369A 5501. Only removals for failure are considered; removals for crash and combat damage have been excluded.

Mean Time to Removal	Hours
Shaft	400
Coupling	565

Failure rate data for coupling P/N 369A 5517 are not available. This component is not stocked but provided by issue of the next higher assembly, the shaft asser y

Problem No.: 04-1 (Continued)

Ft. Rucker demand data for the year ending 30 April 1971 show mean times between replacement as follows:

	Hours
Shaft	930
Coupling (P/N 369A5501)	725

These factors do not consider shafts or couplings repaired and returned to use.

The Hughes Tool Company Serialized Assembly Failure History Report shows mean times to removal as:

	Hours	No. of Removals Reported
Shaft	215	37
Coupling (P/N 369A5501)	280	7

F. Mission and Deployment Factors -
Common to all missions and deployments

Problem Impact:

A. Safety Factors -
Failures of the drive shaft and couplings produced a high number of serious mishaps. Of all mishaps recorded by USABAAR during the period 1 January 1967 - 31 March 1971, 11 of 29 total losses and 8 of 32 major mishaps resulted from drive shaft and coupling failures. Additionally, they accounted for 6 of 16 incidents and 9 of 33 forced landings. In total, these failures produced over 30% of all mishaps in these four categories.

B. Maintenance Workload Factors -

Action	P/N	M/H	Level of Maint.
Replace shaft*		1.8 - 2.2	Direct Support
Replace coupling	369A5501	1.5 - 2.0	Direct Support

* Includes coupling P/N 369A5517

Problem No.: 04-1 (Continued)

C. Aircraft Availability Factors -
Aircraft downtime for replacement of either item ranges from 2.5 to 4.0 hours.

Remedial Actions:

1. ECP 334, approved in June 1968 for retrofit only, provided for modification of station 137.5 to provide increased tail rotor drive shaft clearance. Retrofit was provided by MWO 55-1520-214-30/22, November 1968.

2. ECP 1578 approved in November 1968 also provided for increased tail rotor drive clearance effective on production aircraft 68-17164. Retrofit was not approved.

3. ECP 2672, approved in April 1970, provided increased wall thickness of the tail rotor drive shaft with retrofit through attrition only.

Data Sources:

1,2,3,4,6,7,9,10,11,12,14,20,22.

Cross References:

TMS	Problem Number
UH-1	04-1
AH-1	-
CH-47	04-3
CH-54	04-10
OH-6	04-2
OH-58	04-1, 04-2

Helicopter TMS: OH-6A
Problem No.: 04-2

Problem Title: Tail Rotor Hub and Blade Failures and Malfunctions

Problem Description:

A. Component Identification -
Tail Rotor Hub and Blade Assembly, P/N 369A 1600-21

B. Description of Failure -
1. Teetering bearing P/N 369A 1709 wears, fails ; PTFE lining becomes unbonded.
2. Hub corrodes under chrome plating, becomes bent.
3. Blade tip caps loosen, break, suffer bond separation at faying surface.
4. Blade airfoil section collapses.
5. Abrasion strip becomes unbonded.
6. Tail rotor difficult to balance.

Most of these conditions will cause vibration in the helicopter airframe.

C. Cause of Failure -
1. Wear, dirt and dust contamination of PTFE lining; shim failure in the teetering bearing.
2. Hub corrosion - galvanic reaction between chrome plating and hub material - no intermediate coating applied. Hub bending results mainly from F.O.D. and handling damage.
3. Tip cap failures result from poor adhesion of bonding material.
4. Airfoil collapses as a result of inadequate material, quality control.
5. Abrasion strip failures - quality control deficiency.
6. Tail rotor balancing problems caused to a large extent by high RPM of tail rotor blades, high precision requirements, difficulties in seeing strobe light in daylight. Tail rotor balancing problems were discussed by the Aviation Test Board in their reports of the Intensified Confirmatory Test of the OH-6A helicopter in August 1968 and in their report of the Reliability Evaluation of the OH-6A helicopter, also in August 1968.

D. Period and Duration of Problem -
Early deployment to present

Problem No.: 04-2 (Continued)

E. Failure Rate Data -

AVSCOM MIRF data shows a mean time to removal for the hub and blade assembly for failures only, excluding crash damage and combat damage, of 205 hours, based on 441 removals. Ft. Rucker showed a mean time between replacement of 135 hours for the year ending 30 April 1971.

The Hughes Tool Company Report 10, Serialized Assembly Failure History, provides the following mean time to removal:

	Hours	No. of Removals
Tail Rotor Assembly	177	447

Specific failure data for components and assemblies of the OH-6A tail rotor assembly were:

	Hours	No. of Removals
Hub	218	23
Teetering Bearing	223	119
Tail Rotor Blade	140	224

F. Mission and Deployment Factors -

Common to all missions and deployments

Problem Impact:

A. Safety Factors -

Tail rotor failures (excluding transmission and control assembly) present serious safety problems. They accounted for 7 of 29 total losses and 2 of 32 OH-6A major mishaps recorded by USABAAR during the period 1 January 1967 - 31 March 1971. Additionally, 2 forced landings and 15 precautionary landings resulted from tail rotor failures.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace Tail Rotor Assembly (excluding balancing)	2.0 - 3.0	Direct Support

C. Aircraft Availability Factors -

Aircraft downtime for tail rotor replacement is 3 to 5 hours.

Problem No.: 04-2 (Continued)

Remedial Actions:

1. A change in teetering bearing shims, from laminated to one-piece ground steel, was made by the manufacturer.

2. Adhesive material for blade tip caps was changed, and two rivets were installed through the cap and blade skin.

3. Quality assurance and control procedures of manufacture were improved to remedy the collapsing-airfoil problem.

4. Material processing specifications were upgraded by manufacturer to remedy abrasion strip problem.

5. Several attempts have been made to improve blade tracking equipment but with little success. Several persons interviewed felt that the only solution was in a tail rotor system with a lower RPM.

Data Sources:

1,2,3,4,6,7,9,11,13,15,16,19,20,22.

Cross References:

TMS	Problem Number
UH-1	04-1, 04-3
AH-1	04-1
CH-47	04-6
CH-54	04-2
OH-6	04-1, 04-5
OH-58	04-1, 04-3

Helicopter TMS: OH-6A
Problem No.: 04-3

Problem Title: Main Transmission Malfunctions and Failures

Problem Description:

A. Component Identification -

	P/N
Main Transmission Assembly	369A 5100
	369A 5100-601
	369A 5100-603
	369A 5100-605
	369A 5100-607

B. Description of Failure -
Bearings wear, become pitted and spalled, corrode, deteriorate; gear teeth become pitted, spalled, worn; seals fail, permitting oil leakage.

C. Cause of Failure -
Material inability to withstand stresses placed on assembly in combat and training conditions, including overstress, sudden stops, overspeed, etc.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
The AVSCOM MIRF report shows the following mean time to removal (for failures only), excluding removals resulting from crash and combat damage:

P/N	No. of Hours	Sample Size
369A 5100	270	245
369A 5100-601	250	331
369A 5100-603	140	120
369A 5100-605	300	224

Data for P/N 369A 5100-607 were not shown.

Ft. Rucker demand data for the year ending 30 April 1971 showed a mean time between replacement of about 325 hours. This does not include failures corrected by repair.

Problem No.: 04-3 (Continued)

The Hughes Tool Company Report 10, Serialized Assembly Failure History, provides the following mean time to removal data:

P/N	Hours	No. of Removals
369A5100	220	185
369A5100-601	216	209
369A5100-603	164	6
369A5100-605	164	2

Mean times to removal for some of the assemblies and components which produced the transmission removal rate data shown above were:

Component	P/N	Hours	No. of Removals
Input Bevel Pinion Gear Shaft	369A5107	268	20
Output Bevel Pinion Gear Shaft	369A5109	256	72
Input Bevel Gear	369A5108	284	22
Transmission Shaft	369A5158	283	16
Bearing	369A5197	173	127
Bearing	369A5198	194	29
Bearing	369A5199	173	8

F. Mission and Deployment Factors -
Common to all missions and deployments

Problem Impact:

A. Safety Factors -
USABAAR recorded 1 total loss, 2 major mishaps, 2 forced landings, and 24 precautionary landings from transmission failures, from initial deployment through 31 March 1971.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	7.0 - 8.0	Direct Support

Problem No.: 04-3 (Continued)

C. Aircraft Availability Factors -
Downtime for replacement (assuming a two-man crew): 8 - 12 hours.

Remedial Actions:

1. ECP 633, approved in August 1967, provided improved main transmission pump shims for production aircraft 65-12979 through 67-16686. MWO 55-1520-214-30/11, May 1968, provided retrofit.

2. ECP 636, approved in December 1967, improved transmission lubrication effective with production aircraft 66-7900. Retrofit was not authorized.

3. ECP 1321, approved in June 1968, also provided an improved main transmission lubrication system, effective with production aircraft 66-7900. Retrofit was programmed at first transmission overhaul.

4. ECP 1466, approved June 1968, provided an improved transmission run-in, effective with production aircraft 66-7900. Retrofit was programmed at first transmission overhaul.

5. ECP 1889, approved in May 1969, provided an improved high-speed roller bearing in the transmission, to be installed at overhaul of main transmission.

6. ECP 2947, approved in December 1970, provided improved oil pressure in transmission by eliminating internal leakage. Retrofit only was approved with application at transmission overhaul.

There have been five different series of transmissions (as shown in the Component Identification paragraph) during the OH-6A life, with P/N 369A 5100-607 currently the prime. Each of these was designed to produce improvements over earlier types. Failure rate data, shown above for all but the -607 transmission, indicates little improvement in reliability.

Problem No.: 04-3 (Continued)

Data Sources:

1,2,3,4,6,7,9,10,11,12,13,14,20,21,22.

Cross References:

TMS	Problem Number
UH-1	04-4, 04-5, 04-7
AH-1	04-5
CH-47	04-5, 04-6
CH-54	04-7, 04-8
OH-6	04-5
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 04-4

Problem Title: Main Rotor Blade Failures

Problem Description:

A. Component Identification -
Main Rotor Blade, P/N 369A 1100

B. Description of Failure -
Rotor blade failures are categorized as inherent and external. Inherent failures are those resulting from inability of the blade to withstand the stresses for which it was designed. External failures result from stresses beyond that which the blade was designed to withstand, such as crash damage, strikes, combat damage, etc.

Blades removed for inherent causes were worn, deteriorated, corroded, cracked, and delaminated, and had bonding failures. Most blades removed for external causes had encountered damage of an accidental type, such as crash and combat damage, strikes, etc.

C. Cause of Failure -
Inherent failures resulted from design and material inadequacies and, in some cases, quality control failures. External failures result primarily from combat operations, pilot error, and shipping, handling, and storage damage.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
The AVSCOM MIRF report for the OH-6A fleet shows mean time to removal for failures as follows:

Inherent causes: 413 hours (1468 removals)
External causes: 235 hours (2601 removals)

Excessive wear accounted for 55% of all inherent removals, with an additional 12% for cracks.

Combat and crash damage accounted for 37% of all external failures, with dents and punctures accounting for 18% and 8% respectively.

Problem No.: 04-4 (Continued)

Ft. Rucker demand data for the year ending 30 April 1971 show a blade replaced every 105 hours. As there are four blades on the ship, this would indicate a mean time between replacement per blade of about 400 hours, which is close to the MIRF mean time to removal.

Hughes Tool Company Report 10, Serialized Assembly Failure History, shows a mean time to removal of 291 hours based on 100 main rotor blade removals.

F. Mission and Deployment Factors -
Common to all missions and deployments.

Problem Impact:

A. Safety Factors -
Main rotor blade failures have not produced serious safety problems. Only 4 mishaps, all precautionary landings, were recorded by USABAAR during the period from initial deployment through 31 March 1971.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	1.0 - 1.5	Direct Support

C. Aircraft Availability Factors -
Downtime for replacement: 1.0 - 2.0 hours, assuming a two-man crew.

Remedial Actions:
None known.

Data Sources:

1,2,3,6,7,9,11,20,22.

Cross References:

TMS	Problem Number
UH-1	-
AH-1	04-3
CH-47	04-1
CH-54	04-1
OH-6	-
OH-58	-

Helicopter TMS: OH-6A
Problem No.: 04-5

Problem Title: Bearing Failures

Problem Description:

A. Component Identification -

	P/N
Pitch Control Bearing	369A 1306
Pitch Control Bearing Retaining Plate	369A 1307-3
"Teetering" Bearing	369A 1709
Tri-Plex Bearing	369A 5138
Roller Bearing	369A 5197
Roller Bearing	369A 5198
Roller Bearing	369A 5420
Ball Bearing, Annular	369A 5423
Swashplate Bearing	369A 7003
Bearing	369A 7951-45
Bearing	369A 7951-23
Bearing	369A 7951-15
Bearing	369A 7951-11

B. Description of Failure -
Bearings became rough, spalled, pitted, worn; liners wear, loosen on PTFE bearings.

C. Cause of Failure -
Contamination by dirt, sand, other abrasives and contaminants; inadequate design and materials to meet operating stresses; inadequate quality control.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
Ft. Rucker demand data for the year ending 30 April 1971 shows the following mean times between replacement:

	P/N	MTBR (hours)
Pitch Control Bearing	369A 1306	65
Pitch Control Bearing Retaining Plate	369A 1307-3	45
Ball Bearing	369A 7951-23	250
Bearing	369A 7951-15	80
Bearing	369A 7951-11	275

Problem No.: 04-5 (Continued)

Several of these bearings have multiple applications, and the mean time between replacement for any one bearing is greater than the times shown above. Nevertheless, at Ft. Rucker, a bearing needed replacement at these average intervals.

The Hughes Tool Company Report 10, Serialized Assembly Failure History, showed the following mean time to removal data for bearings used in the OH-6A:

	P/N	Hours	No. of Removals
Pitch Control Bearing	369A 1306	390	8
Pitch Control Bearing Retaining Plate	369A 1307-3	400	14
Teetering Bearing	369A 1709	119	223
Bearing	369A 5138	249	2
Roller Bearing	369A 5197	172	127
Roller Bearing	369A 5198	194	29
Roller Bearing	369A 5420	273	86
Bearing	369A 5423	362	3
Swashplate Bearing	369A 7003	208	90
Ball Bearing	369A 7951-45	218	36

F. Mission and Deployment Factors -
Common to all missions and deployments

Problem Impact:

A. Safety Factors -
USABAAR recorded only two mishaps (one forced landing and one precautionary landing) resulting from bearing failures from OH-6A initial deployment through 31 March 1971. The specific bearing was not identified in either case.

B. Maintenance Workload Factors -
Bearing replacement manhour requirements vary from one to several manhours depending on the accessibility and degree of disassembly necessary. Many replacements and repairs can only be made at depot level, with bearing replacement one of several removal and replacement actions during component overhaul.

C. Aircraft Availability Factors -
Because most bearings are replaced at depot level, aircraft downtime from bearing failures generally is associated

Problem No.: 04-5 (Continued)

with replacement time for the component of which the bearing is a part.

Downtime normally runs from 1/2 to 2 days, based on tail rotor, transmission and flight control component replacement downtime factors.

Remedial Actions:

Following are known remedial actions:

1. Pitch control bearing - P/N 369A 1306. A new bearing manufacturer was selected.

2. Bearing - P/N 369A 1709. Shims (P/N 369A 1717) changed from laminated to one-piece ground steel to prevent shim deformation and resulting excessive torque to bearing.

3. Product-improvement task to investigate bearing design improvements approved.

4. Bearing 369A 5197. Change in vendor, increase in hardness of material, change in oil and increase in transmission oil capacity, minor geometric changes on rollers and races.

5. Bearing - 369A 5198. New transmission assembly developed with larger oil capacity and nozzle to impinge an oil jet directly on the bearing.

6. Bearing - 369A 5138. Replaced by bearing P/N MM7207PW3DT DBE 5821.

7. Bearing - 369A 5420. Manufacturing requirements made more stringent, slight geometric changes made to improve lubrication characteristics.

Data Sources:

1,2,3,4,6,7,9,15,16,20,21,22.

Problem No.: 04-5 (Continued)

Cross References:

TMS	Problem Number
UH-1	04-1, 04-2, 04-4, 04-8, 04-9, 04-10
AH-1	04-1, 04-4
CH-47	04-6
CH-54	04-7, 04-11, 18-1
OH-6	04-2, 04-3
OH-58	04-1, 04-3

Helicopter TMS: OH-6A
Problem No.: 09-1

Problem Title: Battery Malfunctions and Failures

Problem Description:

A. Component Identification -
Battery, P/N 19KO 14L

B. Description of Failure -
Battery overheats, spills over, smokes, leaks, burns. Overheating is the principal failure symptom.

C. Cause of Failure -
Not specifically identified. Location of the drain, venting, and location of connectors were all stated as possible causes.

D. Period and Duration of Problem -
Early deployment to present. Battery problems were listed as a major discrepancy in the report of The Intensified Confirmatory Test of the OH-6A (Data Source 16) conducted in 1967-1968.

E. Failure Rate Data -
Little failure rate data for batteries have been found. In the Intensified Confirmatory Test noted above, 23 battery failures were recorded in 5269 flying hours for a mean time between failures of about 270 hours. Six batteries were used in 3200 hours of flying in the Reliability Evaluation of the OH-6A, also conducted in 1967 and 1968.

F. Mission and Deployment Factors -
Common to all missions and deployments

Problem Impact:

A. Safety Factors -
Battery failures have not caused serious mishaps but have produced a high number of minor safety problems. USABAAR records for the period 1 January 1967 - 31 March 1971 show that battery malfunctions caused 19 precautionary landings (of a total of 131), 3 forced landings, and 1 incident.

Problem No.: 09-1 (Continued)

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	0.4 - 0.6	Organizational

C. Aircraft Availability Factors -
Downtime for battery replacement: 0.5 - 1.0 hour.

Remedial Actions:

It was stated that vendors had been changed and that different insulation and different installation fittings had been used. No other actions have been identified.

Data Sources:

1,2,3,4,8,9,15,16.

Cross References:

TMS	Problem Number
UH-1	-
AH-1	-
CH-47	-
CH-54	-
OH-6	-
OH-58	-

Helicopter TMS: OH-58A
Problem No.: 01-1

Problem Title: Armor Side Panel Hinge Assembly Malfunctions

Problem Description:

A. Component Identification -

Hinge Assembly, RH, P/N H1080-1, -7

B. Description of Failure -

1. Hinge assembly retaining pin breaks.

2. Hinge assembly will not stay closed, resulting in inadvertent opening of armor side panel. Open armor side panel during flight acts as a speed brake and can affect stability and control.

C. Cause of Failure -

1. Inadequate design.

2. Inadequate penetration of latch pin into its slot in the P/N 206-070-370-1 fitting (at least 1/4 inch engagement required).

D. Period and Duration of Problem -

1969 to present

E. Failure Rate Data -

Based on hinge assembly replacements at Ft. Rucker during the year ending 30 April 1971, observed MTBR (for failures requiring assembly replacement) is 309 hours. Failures corrected by repair are not included in this MTBR.

F. Mission and Deployment Factors -

Common to all missions and deployments

Problem Impact:

A. Safety Factors -

Aircraft mishap data covering OH-58A operations from initial deployment to 31 March 1971 show no mishaps attributed to hinge assembly failures and malfunctions. As noted above, however, hinge assembly failures can affect flight dynamics if the armor side panel opens during flight. As such, hinge assembly failures constitute a potential safety problem.

Problem No.: 01-1 (Continued)

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Repair/replace	0.5 - 1.0	Organizational

C. Aircraft Availability Factors -

Aircraft downtime for corrective action is approximately 1 - 2 hours.

Remedial Actions:

1. Hinge assembly P/N H1080-1 replaced by P/N H1080-7 effective with aircraft S/N 68-16728 and subsequent. This assembly provides deeper pin engagement than that afforded by the -1 assembly, to eliminate inadvertent opening of armor side panel during flight.

2. Recommended field procedure to correct inadequate pin engagement (less than 1/4 inch) is shimming of the fitting (P/N 206-070-370-1) to obtain an acceptable amount of pin engagement.

3. The feasibility of designing a new hinge assembly is currently under study.

Data Sources:

1,2,3,4,5,6,8,9,10,16,17.

Cross References:

TMS	Problem Number
UH-1	01-3
AH-1	01-4, 01-6
CH-47	01-4
CH-54	-
OH-6	01-4
OH-58	01-2

Helicopter TMS: OH-58A
Problem No.: 01-2

Problem Title: Crew Door, Passenger Door, and Cowl Access Door Latches and Related Hardware Failures and Malfunctions

Problem Description:

A. Component Identification -

	P/N
Crew Door, RH	206-032-500-4
Crew Door, LH	206-032-500-7
Passenger Door, RH	206-032-501-4
Passenger Door, LH	206-032-501-9
Crew Door Latch Installation, LH	206-032-516-3
Crew Door Latch Installation, RH	206-032-516-4
Engine Access Door	206-061-805-7
Cowl Installation Door Assembly, LH	206-062-815-9
Cowl Installation Door Assembly, RH	206-062-815-10

B. Description of Failure -

1. Door latch and latch part failures and malfunctions include cracking, breaking and bending. Parts failing include liners, pins, springs, etc.

2. Latches go out of adjustment, and fail to engage or disengage properly.

3. Doors crack around hinge mounting points.

C. Cause of Failure -

Door hardware failures generally result from a combination of inadequate design (including tolerances), inadequate material strength, hard usage (frequent opening and closing, forcing, slamming, twisting, etc.), and vibration resulting from aircraft and weapon system operation.

D. Period and Duration of Problem -

Initial deployment to present

Problem No.: 01-2 (Continued)

E. Failure Rate Data -

Little data is available on these failures and malfunctions since most corrective action consists of repair and adjustment rather than latch and door assembly replacement. Based on replacement data for the OH-58A fleet at Ft. Rucker during the year ending 30 April 1971, a pilot or copilot crew door is replaced every 1235 flying hours, and a passenger door every 2881 flying hours. Latches on the engine access door (P/N 206-061-805-7) are replaced every 846 flying hours. Based on OH-58A limited maintenance test data by the Aviation Test Board, corrective maintenance on doors, door latches, and related hardware is required approximately every nine flying hours.

F. Mission and Deployment Factors -

Common to all missions and deployments.

Problem Impact:

A. Safety Factors -

There were no aircraft mishaps attributed in USABAAR data to door and door hardware failures in the period commencing with initial deployment through 31 March 1971.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace doors	2.0 - 3.0	Organizational
Minor repairs	1.0 - 1.5	Organizational
Other repairs	2.0 - 4.0	Direct Support

C. Aircraft Availability Factors -

Aircraft downtime for corrective maintenance ranges from one hour to two days, depending upon the type of repair and the maintenance level of accomplishment. Although elapsed maintenance time at direct support generally ranges from two to four hours, administrative and production lag time can extend downtime to one day or more.

Remedial Actions:

1. ECP 025, Improved Passenger Door Handles, approved December 1969, for incorporation on production aircraft S/N 68-16687 through 68-16785, with retrofit application through attrition.

Problem No.: 01-2 (Continued)

2. ECP 055, Improved Left-Hand Crew Door Latching Device, approved January 1970, for production incorporation on aircraft S/N 68-16687 through 68-16929. Retrofit through MWO 55-1520-228-30/3 (Urgent), March 1970. This change increases the tension in the door latch over-centering mechanism to insure positive latch engagement and prevent door from opening during gun-firing.

3. Effective with aircraft S/N 68-16752 and subsequent, ECP 1187 thickened the outer skin of crew doors to prevent cracking. As a result of this ECP, crew door P/N 206-032-500-3 was superseded by P/N 206-032-500-7.

Data Sources:

1,2,3,4,5,6,7,8,9,10,15,16,17.

Cross References:

TMS	Problem Number
UH-1	01-3
AH-1	01-4, 01-6
CH-47	01-4, 01-5
CH-54	-
OH-6	01-4
OH-58	01-1

Helicopter TMS: OH-58A
Problem No.: 01-3

Problem Title: Fastener and Rivet Failures

Problem Description:

A. Component Identification -
Fasteners and rivets used on the cowl installation, P/N 206-062-800-3.

B. Description of Failure -
Dzus fasteners on the transmission and engine cowl assembly doors crack, break, and fall off. Rivets on the same assemblies, as well as on the particle separator, shear, pop, and are dislodged. In some cases, aircraft skin is bent and pulled around rivets.

C. Cause of Failure -
Primary causes of fastener failure are vibration, wear, and forced closing of improperly aligned doors and panels. Rivet failures result from stress around hinges, vibration, and slamming of doors.

D. Period and Duration of Problem -
Initial deployment to present

E. Failure Rate Data -
Data on this type of hardware failure is practically nonexistent, since corrective action is ordinarily included in other maintenance action reporting, e.g., inspections, sheet metal work, etc. Based on limited test data maintenance records, however, the estimated MTBF of rivets and fasteners on the cowl installation is on the order of 40-50 flying hours.

F. Mission and Deployment Factors -
Common to all missions and deployments.

Problem Impact:

A. Safety Factors -
No OH-58A aircraft mishaps have been attributed to fastener and rivet failures in USABAAR data covering the period from initial deployment through 31 March 1971.

Problem No.: 01-3 (Continued)

B. Maintenance Workload Factors -

Rivet and fastener replacements are ordinarily accomplished by sheet metal skills at direct support maintenance. Manhour requirements for individual fastener and/or rivet maintenance are relatively small. Problems of accessibility as well as the number of items requiring corrective action (due to deferred maintenance) often increase the manhour requirements per maintenance event.

C. Aircraft Availability Factors -

Downtime for rivet and fastener replacement is not known. It will vary with the extent of replacements made and manhours required, and is also related to inspection downtime requirements.

Remedial Actions:

None known.

Data Sources:

1,2,3,5,6,8,9,11,16.

Cross References:

TMS	Problem Number
UH-1	01-5
AH-1	01-1, 01-4, 01-8
CH-47	01-1
CH-54	-
OH-6	01-4, 01-5
OH-58	-

Helicopter TMS: OH-58A
Problem No.: 04-1

Problem Title: Tail Rotor Drive Shaft Component Failures

Problem Description:

A. Component Identification -

	P/N
Shaft Assembly	206-040-330-9
Collar	206-040-315-1
Bearing	206-040-339-3

B. Description of Failure -

1. Shaft assembly failures include pitting and corrosion, shaft grooved under rubber collar; drive shaft subject to frequent misalignment.

2. Collars are difficult to install properly. Improper installation of collar results in collar wobbling, damage to shaft, and collar failure, which in some cases consists of collar being fused to drive shaft.

3. Bearings wear excessively and seize.

C. Cause of Failure -

The main causes of shaft assembly, collar and bearing failures are interrelated and result from improper drive shaft alignment, which produces vibration and uneven wear. Proper drive shaft alignment requires correct installation of collars (perpendicular to shaft) and bearings and proper shimming of bearings. Improper installation of collars results in bearing wobble and subsequent failure due to bearing seizure resulting from overheating (over 180°F).

D. Period and Duration of Problem -

Early deployment to present

E. Failure Rate Data -

Based on replacements (issues) at Ft. Rucker during the year ending 30 April 1971, observed MTBRs are:

	P/N	MTBR (hours)
Shaft Assembly	206-040-330-9	1081
Collar	206-040-315-1	88
Bearing	206-040-339-3	86

Problem No.: 04-1 (Continued)

F. Mission and Deployment Factors -
Common to all missions and deployments.

Problem Impact:

A. Safety Factors -
Deliveries of OH-58A aircraft began in May 1969. Through 31 March 1971, one precautionary landing was attributed to hanger bearing failure. The total loss of one aircraft occurred during this period due to suspected tail rotor failure. It is not possible to ascertain from the mishap data available to this study whether there was any connection between the suspected tail rotor failure and this problem area.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace drive shaft	2.0 - 3.0	Organizational
Adjust drive shaft	.5 - 1.5	Organizational
Replace bearing/collar	1.5 - 2.5	Organizational
Adjust bearing/collar	.5 - 2.0	Organizational

C. Aircraft Availability Factors -
Average downtime for tail rotor drive shaft and bearing maintenance ranges from 1 - 4 hours.

Remedial Action:

1. The following advisory communications were issued providing drive shaft alignment instructions:
   a. TWX AMSAV-R-EYD 30 1845Z, December 1970.
   b. TB 750-992-1 C2, January 1971.

2. ECP 092, Improved Drive Shaft Bearing and Seal, was approved in September 1970 for production incorporation. This ECP was to provide a new hanger bearing and a different rubber collar, shield and deflector. Revision 1 (ECP 092R1), April 1971, deleted that part of the basic ECP pertaining to bearing shields and collars due to design difficulties.

3. A product improvement test of improved tail rotor drive shaft hanger bearings was conducted by the Aviation Test Board from 23 October 1970 to 23 April 1971. Total time on the aircraft with the test bearing was 440 hours.

Problem No.: 04-1 (Continued)

Among the results of the test were:

a. Bearings were difficult to install.
b. Bushings moved on the shaft and caused the protective shield to separate from the bearing.
c. Bearings became excessively loose and noisy after 440 hours of operation.

The bearings tested differed from the standard (-339-3) bearings as follows:

1. A redesigned rubber bushing incorporated ridges on its circumference to resist longitudinal bearing movement.

2. A plastic cover was added to protect the bearing from dust and moisture.

3. Incorporation of a readily adjustable self-aligning feature to eliminate the necessity for bearing alignment actions and realignment by use of shims.

4. Improved grease-retaining features.

5. A harder inner surface for the bearing race.

Data Sources:

1,2,3,4,5,6,7,8,9,10,11,15,16,17,18.

Cross References:

TMS	Problem Number
UH-1	04-1
AH-1	-
CH-47	04-3, 04-6
CH-54	04-7, 04-10, 04-11, 18-1
OH-6	04-1, 04-2, 04-5
OH-58	04-2

Helicopter TMS: OH-58A
Problem No.: 04-2

Problem Title: Drive Shaft Assembly (Short Shaft) Coupling Seal Failures

Problem Description:

A. Component Identification -

	P/N
Drive Shaft Assembly	206-040-100-13
Drive Shaft Coupling Seal	206-040-111-7

B. Description of Failure -

1. Seals are subject to excessive tearing and deterioration, with consequent loss of lubricant and damage to the drive shaft splines.

2. A secondary type of failure occurs when units in the field use less grease when packing the coupling than recommended in the TM. This practice can induce coupling failure.

C. Cause of Failure -

1. Inadequate seal strength.
2. Inability of seal to withstand high temperatures.
3. Cone assembly P/N 206-062-901-9 chafes the metal surface of the seal due to inadequate clearance.
4. A suspected contributing cause of seal failure is seal dislodgement resulting from extreme pylon rock as a consequence of hard landings.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
Observed MTBRs on parts usage (issues) at Ft. Rucker during the year ending 30 April 1971 are:

	P/N	Hours
Drive Shaft Assembly	206-040-100-13	960
Coupling Seal	206-040-111-7	752

As there are two coupling seals per assembly, aircraft downtime for seal replacement occurs approximately every 350 hours.

Problem No.: 04-2 (Continued)

F. Mission and Deployment Factors -
Common to all missions and deployments; however, the problem severity has been greatest in Vietnam.

Problem Impact:

A. Safety Factors -
From May 1969 through 31 March 1971, three class 6 mishaps (precautionary landings) were attributed to short shaft material failures or malfunctions. Two short shaft failures and one short shaft throwing grease were identified as causes.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace drive shaft	4.0 - 5.0	Organizational
Replace seal	1.0 - 2.0*	Direct Support

C. Aircraft Availability Factors -
Aircraft downtime for removal and replacement of the shaft assembly will normally range from 5 to 6 hours. Seal replacement at direct support level will not affect downtime unless an aircraft is held down awaiting repair, in which case downtime will be 7 to 8 hours.

Remedial Actions:

1. Class 2 ECP 1584 was approved September 1969 effective with aircraft S/N 68-16756 to eliminate chafing by the -901 cone assembly.

2. Field activities are authorized to cut up to 1/4 inch of material from the cone lip to eliminate cone contact with the seal.

3. ECP 109, Improved Engine to Transmission Coupling Boot, approved January 1971, effective with productive aircraft S/N 7120340, provides for new seal P/N 206-040-138-1 to replace the -111-7 seal. Retrofit by attrition.

Data Sources:

1,2,3,4,5,6,7,15,16,17.

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* With drive shaft previously removed from the aircraft.

Problem No.: 04-2 (Continued)

Cross References:

TMS	Problem Number
UH-1	04-3, 04-5, 04-7
AH-1	04-5
CH-47	04-5
CH-54	04-3, 04-8, 04-11, 18-1
OH-6	04-1
OH-58	04-1

Helicopter TMS: OH-58A
Problem No.: 04-3

Problem Title: Tail Rotor Hub Failures and Malfunctions

Problem Description:

A. Component Identification -

	P/N
Tail Rotor Trunnion Assembly	206-011-803-5
Pitch Change Link	206-010-710-1,-3

B. Description of Failure -

1. Trunnion loses preload, resulting in high-frequency vibration.

2. Pitch change link bearing wears excessively.

C. Cause of Failure -

1. The causes of loss of trunnion preloading have not been established. Wear is thought to be the primary cause, also failure of the bearing PTFE.

2. Pitch change link bearings not properly retained in the link. The ring stake on the 710-1 link was found to be frequently not centered on the bearing circumference. The 710-3 link utilizes the roll staking method which retains the bearing in the link better.

D. Period and Duration of Problem -
Early deployment to present

E. Failure Rate Data -
Based on parts/component replacements (issues) over 8644 flying hours at Ft. Rucker during the year ending 30 April 1971, observed mean times between replacement are:

	P/N	Hours
Trunnion Assembly	206-011-803-5	617
Link	206-010-710-3	346*

* As there are two links per aircraft, the MTBR for any one link is about 692 hours.

Problem No.: 04-3 (Continued)

F. Mission and Deployment Factors -

Common to all missions and deployments. Loss of trunnion preload may have a higher observed rate at Ft. Rucker due to closer inspections by new instructor pilots.

Problem Impact:

A. Safety Factors -

Of the two OH-58A total loss mishaps recorded by USABAAR through 31 March 1971, one was due to "suspected tail rotor failure". Further details are not provided, and it is not possible to determine the connection, if any, between this problem area and the loss of the aircraft. No other mishaps have been attributed to this problem area.

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace pitch change link	0.5 - 1.5	Organizational
Replace trunnion assembly	1.0 - 4.5	Direct Support

C. Aircraft Availability Factors -

Aircraft downtime required for corrective maintenance action will range from 1.0 to 5.5 hours, with an average downtime of about 2 hours.

Remedial Actions:

1. A field procedure for inspecting and adjusting trunnion preload was developed (SEM 58-05-91-1) and incorporated in the technical manuals.

2. Pitch link P/N 206-010-710-1 replaced by the P/N 206-010-710-3 link, which utilizes roll staking instead of ring staking for retention of link bearings.

Data Sources:

1,2,3,4,5,6,7,8,9,15,16,17.

Problem No.: 04-3 (Continued)

Cross References:

TMS	Problem Number
UH-1	04-1
AH-1	04-1
CH-47	04-6
CH-54	04-7, 04-11, 18-1
OH-6	04-2, 04-5
OH-58	-

Helicopter TMS: OH-58A
Problem No.: 11-1

Problem Title: Flight Control Servo Actuator Failures

Problem Description:

A. Component Identification -

Servo Actuator, P/N 206-076-031-1

B. Description of Failure -
1. Loss of packing in forward end of servo.
2. Erratic operation.
3. Servo leaking excessively.

C. Cause of Failure -
1. Loss of packing due to poor quality control during assembly.
2. Cause of erratic operation not known.
3. Servo leakage due to seal damage results from maintenance practice of wiping the actuator rod dry and failing to re-lubricate the rod to prevent rusting. Also, lack of adequate care in cleaning dirt and grit from rod results in rod scoring and abrasion.

D. Period and Duration of Problem -
Initial deployment to present

E. Failure Rate Data -
Based on servo replacements at Ft. Rucker during the year ending 30 April 1971, observed MTBR is 927 component hours and 309 aircraft hours (three servos per aircraft).

F. Mission and Deployment Factors -
Common to all missions and deployments; however, damage to actuator rod from abrasive contaminants is greater in sand and dust environments such as Vietnam and Ft. Rucker.

Problem Impact:

A. Safety Factors -
One class 6 mishap (precautionary landing) was attributed to servo failure during the period from introduction of the OH-6A through 31 March 1971.

Problem No.: 11-1 (Continued)

B. Maintenance Workload Factors -

Action	M/H	Level of Maint.
Replace	1.5 - 2.0	Organizational

C. Aircraft Availabil ty Factors -
Aircraft downtime for servo replacement is 2 to 3 hours.

Remedial Actions:

ECP 1953 effective with aircraft S/N 70-15050 and subsequent provides a new actuator P/N 206-076-031-3 to replace the -031-1 assembly.

Data Sources:

1,2,3,4,5,6,7,15,16,17.

Cross References:

TMS	Problem Number
UH-1	06-1
AH-1	06-2, 06-3
CH-47	06-1
CH-54	06-3, 06-4
OH-6	-
OH-58	-

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13. ABSTRACT

This volume presents discussions of a series of reliability and maintainability problems related to Army Light Observation Helicopters (OH-6, OH-58). A detailed discussion of the standard format used for problem presentation and of the various analysis elements within the standard format is provided in Volume I.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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TH-1						
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